Snip Mine - An Upaate

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Abstract

The Snip Mine, which is operated by Cominco on behalf of a joint venture between Cominco Ltd. and Prime Resources Group Inc., is located in northwest British Columbia on the Iskut/Stikine River system 80 air kilometres east of Wrangell, Alaska. It is a high grade underground gold mine employing 135 people on a fly-in (28 days), fly-out (14 days) basis producing 470 tpd. Labour intensive mining methods include conventional jackleg cut and fill, mechanized cut and fill as well as some shrinkage stoping. The metallurgical plant is a straightforward gravity/flotation operation producing dore metal and a pyrite-gold concentrate which is treated off site.

The operation is faced with many challenges, including operating on the banks of a major salmon spawning river system, and containing costs in a remote location. Difficulties in transportation logistics are met by use of freighter hovercraft, supplemented by aircraft support.

Introduction

Exploration of the area dates back to the late 1920's, although intensive exploration of the Snip claims only began in 1986. The name derives from the nearby prominent Snippaker Mountain. At the end of 1989, the decision was made to develop the high grade narrow vein underground deposit, with construction of the conventional gravity/flotation concentrator and other facilities commencing in June 1990. Mine production by cut and fill methods began the following January at the initial design rate of 300 tonne/day, increasing to the present rate of 470 tpd.

Snip has approximately four years of production remaining in the presently delineated ore zones. The 500,000 ounce production milestone was recently achieved. An active underground exploration program continues to add mineable tonnage to reserves, while surface programs seek to discover new ore bodies.

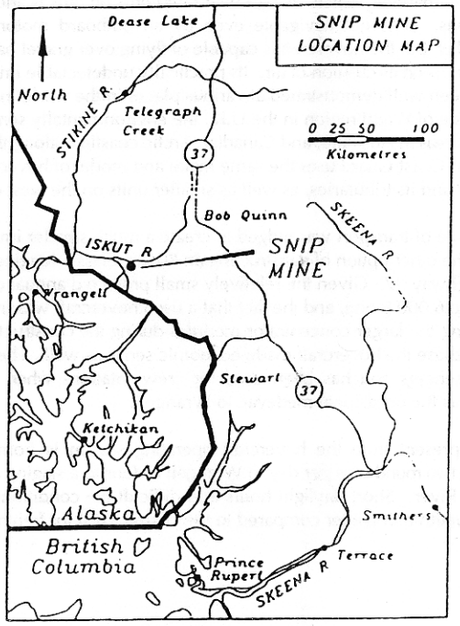
Geology And Exploration

The Snip property is underlain by a sequence of Triassic feldspathic greywackes, siltstones and mafic tuffs. The main ore body, called the Twin Zone, is a 0.5 to 15 m thick quartz-carbonate-sulphide filled shear structure within the greywacke unit. Gold primarily occurs as finely disseminated grains along pyrite grain boundaries. Other sulphides within the Twin Zone include pyrrhotite, chalcopyrite and sphalerite, with trace arsenopyrite.

The vein structure has been traced over a strike length of 1,000 m, has a known vertical extent of 500 m, strikes at 120° and dips southwest at 40 ° to 60 °. For most of its length the vein occurs in two parts, separated by a post-mineralization fine grained basic dyke, hence the name "twin".

Secondary narrow high grade footwall vein structures at a strike of about 150° have been discovered by mine development and infill drilling over much of the mine area. Mine planning is complicated by cross cutting faults which offset the veins. The ore body subcrops to surface over half its strike length.

An ore reserve of 940,000 tonnes grading 28.5 g/t of inferred ore, inclusive of an assumed 20% mining dilution factor, was used for feasibility study proposes in late 1989.



Mining

Cut and fill mining is the predominant method used at Snip, while a few stopes dip steeply enough to permit the use of shrinkage methods. In wider parts of the ore body, an electric-hydraulic single boom jumbo drills flat breast holes, and 4 cu yd LHD units muck the ore to an orepass on the level. Stope cleanup is done with a 1¼ cu yd LHD unit with a "long-billed" bucket. Generally, development waste is hauled into the stope for backfill and then hydraulic sandfill is used to fill the voids. A cap is poured, providing a level surface for mining the next lift.

In narrower parts of the ore body, conventional hand held drills are used to drill flat breasts or uppers. Muck in conventional cut and fill stopes is slushed to bolted section steel mill holes, which are raised along with the timbered manways to enable pouring hydraulic sandfill for the next lift. The first, or undercut lift of both conventional and mechanized stopes is backfilled with a reinforced cemented fill, called a sill mat, which permits the sill pillar to be completely extracted as the stope below approaches the sill mat.

Ground conditions are moderately good although the highly jointed basalt dyke in the middle of the ore body consistently requires rock bolting. In mechanized areas, cable bolts and 6 m super Swellex bolts are used to presupport larger spans. Standard bolting is done with 2.4 m or 3 m split set bolts installed with either a scissor bolter or a jumbo.

Ore-waste boundaries can occasionally be well defined, but usually the presence of small stringer veinlets in the footwall give rise to an assay boundary between ore and waste. Stope limits in a horizontal sense are also usually determined by "exploring" under geological control, although occasionally stopes can be fault-bounded. Dilution control is maintained by geologists on both day and night shifts, which has resulted in overall mining dilution to date being less than half the pre-production estimate of 20%.

Ore and waste passes in the footwall of the ore body direct these materials to Norcast chutes on the 180 m level, from where the ore is trucked 1 km down to the 130 portal and then 0.5 km to the ore dump grizzly at the concentrator. The same 15 tonne trucks haul waste as required to the mill for the production of supplementary sand fill.

A 150 HP, 900 psi GEHO piston diaphragm pump on the 180 m level takes a flow of hydraulic sandfill at 60 - 65% solids from a similar pump located at the concentrator and lifts it to the 440 m level.

Primary ventilation air intakes at the 130 m portal, travels up the main spiral ramp where it is pulled off at the mining levels. Exhaust air raises at the end of mining levels discharge to the two primary exhaust portals - at 300 m, equipped with 2 - 100 HP fans and at 420 m equipped with 2 - 75 HP fans. The main air intake is equipped with 6 million BTU/hr. diesel fired heaters required for temperatures below -5°C.

Concentrator

Bench scale metallurgical tests performed on ore samples taken early in the exploration program indicated that the ore was clean and free milling. The initial

flowsheet called for a conventional cyanidation/Merrill-Crowe precipitation milling process yielding about 96% overall recovery. However the proximity of the plant to the Iskut/Stikine salmon river system created considerable difficulty in designing safeguards to contain the cyanide. In the end it was judged a worthwhile compromise to eliminate the possibility of cyanide escapement and accept an approximate 5% loss of recovery by using the more benign gravity/flotation gold milling process. In addition to the $40 million sacrifice of revenue, concentrate haulage by aircraft and hovercraft costs an incremental $1 million annually. On the positive side, plant capital costs were reduced by elimination of the cyanide circuit, the cyanide neutralization plant and the required containment facilities.

A surplus 200 tpd flotation concentrator was purchased as the nucleus of the mill. It had been designed as a modular plant, comprising 14 prefabricated truck sized process equipment pods which were hauled to a remote mine site northeast of Yellowknife, NWT, assembled and commissioned in about a two week period. To provide for a larger throughput rate at Snip, a new 24" x 36" jaw crusher, 4¼' SH cone crusher, and 8' x 12' ball mill were added to the front end of the mill. Some of the modularized concept was retained, mainly in the fine ore bin/feeders section, while the balance of the used equipment: gravity tables, flotation banks, regrind mills, cyclones, dore furnace, thickener, filter and pumps were designed into a new 6,000 sq. ft. building shell.

The finely disseminated gold ore requires a fine grind (80% - 200 #) for acceptable flotation recovery, and consequently only about 30% of total throughput is coarse enough to make acceptable hydraulic sandfill for the mine. A separate circuit was installed in the concentrator, using the original 7' x 7' ball mill, to grind and classify waste rock to provide supplementary sandfill as required by underground stoping cycles. The sandfill plant incorporates a 750 tonne sand storage bin and a 150 HP 900 psi GEHO piston diaphragm pump which moves 31 m^3/hour of slurry at 65% solids 1,500 m horizontally and 65 m vertically to a relay station within the mine.

As throughput increased from 350 to 470 tpd, the disc filter lacked capacity to produce concentrate of acceptable moisture content and so a used Larox filter was added to make a product with a 7-8% moisture content. Other fine tuning has increased the gravity circuit recovery by nearly a half to 35%, which combines with a flotation recovery of 56%, for an overall 91% recovery. This is based on a throughput rate of 470 tonne/day, at a grade of just under 30 g/t for 1993. The very clean concentrate typically grades 320 g/t Au and 150 g/t Ag.

Tailings are pumped 2.2 km to a 11 ha tailings pond at the head of a valley located below the mine workings in the mountainside. The pipeline enters one portal of the mine and exits another to avoid an avalanche/rock slide area on surface. Tailings water, along with run-off into the pond, is seasonally decanted directly into a small water course called the Monsoon Creek/Lake system which discharges into the Iskut River. During summer, evaporation and pond seepage is greater than in-flow. Discharge water quality limits are set very conservatively, are monitored frequently, and have not been exceeded since start up.

Support Facilities

The four bay maintenance shop with separate electrical, hydraulic rebuild and machine shop areas is located in a multipurpose building alongside the warehouse, change room facilities and assay lab. Administration and technical offices are located on the second floor.

A four unit, 3.4 mW diesel generating plant is located in the concentrator building. An attached cooling system heat recovery plant is able to heat the mill, service building and the 170 person accommodation complex except on the coldest winter days, when supplementary boiler heat is added to the glycol delivery system. All buildings are completely sprinklered, that system being fed from a 750,000 gal water bladder by a stand-alone high pressure pump which starts automatically when a drop in pressure is sensed.

Transport

A 4,500 foot gravel airstrip was constructed in 1988, 0.5 km from the present Snip plant site. It served as the base for over a dozen different exploration projects in those active years up to 1990, and accommodates planes up to the size of a Lockheed C-130 Hercules. Snip construction in 1990 required three one week Hercules mobilizations for earth moving equipment and construction materials.

Rugged mountainous terrain and sporadic foul weather combine to produce a uniquely hostile operating environment for aircraft. The airstrip can be approached only in daylight visual conditions; winter fogs have prevented landings for periods of up to 5 and occasionally 7 days.

An amphibious hovercraft was purchased in 1990 and converted from its 77 passenger configuration to an open deck freighter with a rated capacity of 10 tonnes under sea going conditions with up to 2 m waves. The Iskut River is a braided system with many separate channels which change with rapid erosion effects and blockages by snags and trees. It is not navigable even by an outboard motor boat with conventional propeller, but the hovercraft is capable of flying over gravel bars, shallow water and ice and snow on its cushion of air. Its practically undetectable impact on the environment had been well demonstrated at various places in the world including the heavily populated Isle of Wight region in the U.K., the environmentally sensitive Gold Coast and Brisbane areas in Australia, and Canadian Arctic coastline along the Beaufort Sea. The Canadian Coast Guard uses the same make and model of hovercraft on the St. Lawrence River and its tributaries, as well as smaller units on the west coast.

This mode of transport was judged to create a much smaller impact on the environment than the other option of constructing an 80 km Class 5 logging road from Bob Quinn on Highway 37. Given the relatively small projected annual concentrate production of around 6,000 tonne, and the fact that a used hovercraft was immediately available for moving the larger concentrator modules during the construction period, the decision to purchase the hovercraft made economic sense as well. The hovercraft can carry 20 passengers and has been used for crew rotations when planes are grounded, as well as the occasional medevac to Wrangell.

At the present time the hovercraft operating season is from March to November, making two round trips per day to Wrangell or four to a staging area on the navigable Stikine River. Short daylight hours and difficult ice conditions make the hovercraft uncompetitive in winter compared to the charter DC4 for freight hauls.

Organization, Personnel

The 135 person operation is self contained, with procurement, accounting and personnel services on site. All employees work a rotation of 28 days on site followed by 14 days at home, with transportation provided to any airport in B.C., as well as Calgary and Edmonton, Alberta, and Whitehorse, Yukon. Weekly charters provide service directly from Vancouver, Smithers and Dease Lake/Telegraph Creek.

Work schedules are 10 hours per day, seven days per week. The standard 2 to 4 week annual vacations enable employees to add to the two weeks "out" for substantial holidays. The operation runs through Christmas with somewhat reduced crews. Those employees scheduled to work during this period are encouraged to bring spouses and children to site at company expense for what is generally regarded as a very special week. A number of cabins used during the exploration phase were modernized to self contained guest cottages, which employees are able to use during summer for visiting family who are offered partially subsidized air tickets.

Primary accommodation is in a two-floor complex centred around kitchen/dining room with TV and reading rooms on the second floor. Two bedroom wings having a total of 170 small single rooms and adequate common washroom and laundry facilities on each floor of each wing. A selection of satellite TV stations is available, most employees have their own TV and personal phone in their rooms. A separate building 50 m from the accommodation complex includes a well equipped exercise and weight training gym, hot tub, games rooms and a bar/lounge area which is used for a variety of social activities as well as occasional company meetings. The Bronson Creek Social Club, with a membership of 135, operates the bar at a modest profit from which some of the social club furnishings, as well as outdoor games facilities and a nicely equipped woodworking/hobby shop were funded. Highly skilled volunteer labour is readily available for such after hour projects as building an outboard jet pump driven aluminum fishing boat.

The mine was set up as a non-union operation, with hourly rated employees being offered a benefits package comparable to the staff package. The nominal work year is about 2,400 hours, standard overtime rates are paid because the underlying philosophy was to make the jobs attractive to high calibre employees who were willing to give up normal home life for a few years in return for significant earnings. Employee turnover since start up, including company inter-operation transfer, has averaged 12% per year.

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